COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF PUBLIC INSTRUCTION

Organization and Course of Study for Evening Classes in Bituminous Coal Mining

Bulletin No. 5
Harrisburg
1925

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FOREWORD

Pennsylvania is the greatest coal producing state in the union. (In 1918 more than thirty per cent of all the bituminous coal mined in the country came from Pennsylvania.) As the mines become deeper and mining methods more complex, economy and safety in mining operations require more highly trained officials. The public schools should be in a position to offer instruction which will facilitate safe and efficient coal mining. The State Department of Public Instruction in preparing this bulletin on coal mining education for the bituminous region desires to assist school officials and teachers in providing for the workers of their respective school districts an educational program which will bring to the ambitious ones the opportunity to rise in the mining industry.

Since the State Mining Law requires that certain mine officials have special training and education, the courses which will be outlined in this bulletin deal specifically with instructional material to meet the needs of these men. To make the work of installing and operating classes more effective, the State Department of Public Instruction desires to co-operate with all agencies interested in better education for mining communities. Especially should there be close co-operation between the State Department of Public Instruction, the State Department of Mines and its inspectors, the several collegiate schools of mining in the state and public school administrators and teachers.

Constructive suggestions and criticisms of the material contained in this bulletin will be welcomed.

The Department of Public Instruction desires to express its appreciation for the valuable assistance given by the following agencies and persons in the development of this bulletin:

Pennsylvania Department of Mines; School of Mines, The Pennsylvania State College; Dr. A. S. Hurrell, Assistant Dean of Teacher Training Extension, The Pennsylvania State College. Valuable contributions to this work in the form of constructive criticisms and suggestions in regard to subject matter for the various lesson units were made by Mr. R. Z. Virgin, Assistant Director of Mining Extension, Carnegie Institute of Technology; Messrs. Alexander McCanch, Nicholas Evans and P. J. Callaghan, State Inspectors in the bituminous coal region of Pennsylvania; Mr. James Killius, Director of Vocational Education, Johnstown; Mr. Thomas M. White, Instructor in Mining, Johnstown Night School.

This bulletin was prepared under the direction of Deputy Superintendent L. H. Dennis by William Penn Loomis, formerly Supervisor of Industrial Education, Pennsylvania Department of Public Instruction, now Professor of Industrial Education, the Pennsylvania State College.

Francis B. Haas, Supt. of Public Instruction.

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PART I.

THE NEED FOR INDUSTRIAL EDUCATION IN MINING COMMUNITIES OF THE BITUMINOUS REGION

There is a real need for industrial education in coal mining towns of central and southwestern Pennsylvania. Some of these communities are comparatively small and wholly dependent on mining for their existence. Others have industry in addition to mining but in these cases a large number of men are usually employed at mining work in the community and surrounding territory.

While a variety of types of courses might be given for trade and industrial training in coal mining communities, the demand for such training which is most evident is found in connection with the preparation of experienced miners as minor officials in the mines. These men are required to procure special educational qualifications to supplement their practical experience before they are permitted to hold the positions of mine foremen (first grade), assistant mine foremen, mine foremen (second grade) or fireboss.

To give an idea of the scope of this educational effort on the part of miners employed in the bituminous region, it is significant to know that in 1921, one thousand, two hundred eighteen men took the State examination for mine foremen in the thirty districts of the bituminous region and nine hundred twenty-five men took the examination for fireboss in the same territory. The yearly absorbing capacity for positions of this sort is indicated by the fact that in 1920, one hundred ninety men were issued State certificates to be first grade mine foremen, two hundred forty-six men to be assistant mine foremen, one hundred ten men to be second grade foremen and five hundred fifty-two men to be firebosses.

The men who have taken these examinations in the past have prepared for them in various ways. Some have done so by correspondence instruction; some have formed private groups and received instruction from mine officials who have been willing to give up some of their leisure time to assist the men in their study. Mining departments in the Pennsylvania State College, University of Pittsburgh, and the Carnegie Institute of Technology are conducting, or have in the past conducted, extension classes in certain localities for men who wished to prepare themselves for this work. A few of the public school districts have conducted classes very success-

fully. The public school classes are free of tuition. As a part of the free public school system of the Commonwealth, it is the duty of boards of school directors and school officials in mining communities to take an increased interest in this form of education and conduct classes where they are needed.

DESCRIPTION OF COURSES OUTLINED IN THIS BULLETIN

The State Bituminous Mining Law requires that the following minor officials in the mines shall have special experience and education, and that they shall be examined in their work before being granted certificates of qualification:

1. Gaseous Mines:

    A. Fire Boss
    B. Assistant Mine Foreman
    C. First Grade Mine Foreman

2. Non-gaseous Mines:

    A. Second Grade Mine Foreman

Four separate courses are outlined in this bulletin. They are respectively: "English for Evening Classes in Bituminous Coal Mining"; "Arithmetic for Evening Classes in Bituminous Coal Mining;" "Evening Course for Fire Bosses in Bituminous Coal Mines"; "Evening Course for Mine Foreman in Bituminous Coal Mines." (Parts I and II). Successful completion of these courses will meet the preliminary educational requirements for the official positions mentioned above, and will give a foundation for future study and advancement.

The courses in English and arithmetic are really preliminary preparation for the fire bosses and mine foremen's course. In case the members of the classes have sufficient knowledge of English and arithmetic, these subjects need not be taught. If this instruction is given, however, it should be confined to essentials and should be made as interesting as possible by problems having practical application to coal mining.

Fire Bosses

In order to be prepared for the fire boss' State examination, it will be necessary for a man to have the information outlined in the course called "English for Evening Classes in Bituminous Coal

Mining"; "Arithmetic for Evening Classes in Bituminous Coal Mining"; and "Evening Course for Firebosses in Bituminous Coal Mines." Certificates of qualifications for firebosses are issued in accordance with the law by the State Secretary of Mines as follows: "Certificates of qualification as firebosses shall be granted to persons who have given to the Board of Examiners satisfactory evidence of their ability to perform the duties of firebosses in gaseous mines and who shall receive an average of at least sixty-five per centum in the examination, and shall also have undergone an oral examination in the presence of explosive gas."

First Grade Mine Foremen and Assistant Mine Foremen

In order to qualify as a first grade mine foreman or assistant mine foreman, a man should have a knowledge of the subject matter as outlined in the courses, "English for Evening Classes in Bituminous Coal Mining," "Arithmetic for Evening Classes in Bituminous Coal Mining," "Evening Course for Firebosses in Bituminous Coal Mines," and "Evening Course for Mine Foremen in Bituminous Coal Mines." According to the State Mining Law certificates are issued by the State Secretary of Mines as follows: "Certificates of the first grade shall be issued to persons who have given the Board of Examiners satisfactory evidence of their ability to perform the duties of mine foremen in gaseous mines and who shall receive an average of at least eighty per centum in the examination. Certificates of qualification as assistant mine foremen shall be granted to persons who have given the Board of Examiners satisfactory evidence of their ability to perform the duties of assistant mine foremen in gaseous mines, and who have received at least seventy per centum in the examination."

It should be noted that the "Course for Mine Foremen" as outlined in this bulletin, is two years in length. The time has been set to meet the requirements of the average class. Due to the fact that some individuals have in the past completed this work in one year, it is well for teachers to gauge the time given to subjects by the abilities of the individuals in the class. If it is advisable to reduce the time given to the several units, the work of both years may possibly be completed in one year.

Even if the outline is followed in regard to time distribution, the men should be encouraged to take the State examination for mine foremen at the end of the first year. It is likely that the one year of training for this position will make it possible for a number of the men to obtain state certificates as assistant foremen.

Second Grade Mine Foremen

Second grade mine foremen need not have the ability to work in gaseous mines. Their certificates entitle them to work only in non-gaseous mines and are issued by the State Secretary of Mines in accordance with the law as follows: "Certificates of the second grade shall be granted to persons who have given to the Board of Examiners satisfactory evidence of their ability to perform the duties of mine foremen in non-gaseous mines, and who shall have received an average of at least eighty per centum in the examination." Second grade mine foremen, therefore, may prepare themselves for the State examination by having a satisfactory knowledge of English as outlined in the course, "English for Evening Classes in Bituminous Coal Mining"; arithmetic as outlined in "Arithmetic for Evening Classes in Bituminous Coal Mining"; and all of the subjects outlined in "Evening Course for Mine Foremen in Bituminous Coal Mines."

Officials Already Licensed

The course in "English for Evening Classes in Bituminous Coal Mining" should be open to all of those mine officials already licensed who desire to receive the instruction.

PURPOSE OF THE COURSES

The courses outlined in this bulletin are for the purpose of preparing men to be firebosses, assistant mine foremen and mine foremen. In giving the instruction, one objective is preparation of the men for the State examinations which are given in order that they may receive certificates from the State Department of Mines to practice in the official positions mentioned. The ultimate and most important objectives of the courses are to give the men a knowledge of mining which will result in better work in the mines and to furnish them with a basis for study leading to advancement and better compensation.

BUILDINGS AND EQUIPMENT

A room in any building which meets the State requirements for high schools will be acceptable for these classes. The building need not of necessity be a school building if a more suitable or convenient one can be obtained.

If there is a physics and chemistry laboratory practically all of the apparatus which is needed for demonstrating the theoretical principles of chemistry, mechanics, electricity, etc., will be available.

The minimum apparatus which is necessary for giving instruction in the courses for firebosses and mine foremen is: one approved safety lamp; 1 clanny type safety lamp; 1 anemometer; 1 water-gauge; 1 barometer; 1 small fahrenheit thermometer; 1 phychrometer (hygrometer); 1 Burrel's gas detector; 1 carbon monoxide detector; 1 small first aid kit.

Special apparatus for demonstration, such as safety lamps, first aid kits, etc., may often be procured from local mining companies.

Each group should have available for its use a rather complete library of mining literature. Books which are given in the suggestive reference bibliographies or similar ones will make quite a valuable source of material for members of the class and other mining people. Several of the best trade magazines on mining should appear regularly in the mining library.

TEACHERS—TRAINING AND CERTIFICATION

Instructors will usually be selected from local sources. Those persons should be chosen who have the best qualifications from the standpoint of experience in the mines, education and training.

Teachers for English and mathematics: In most cases it will be advisable to have these subjects taught by teachers from the day schools. When such a procedure is followed the teacher must have enough knowledge of mining to make the instruction practical.

Teachers for Firebosses' and Mine Foremen's Courses: These teachers must essentially have experience in the mines. They will be men who have a first hand knowledge of the duties of a fireboss and mine foremen. In almost every mining community there will be found a man or men who have made a study of the technical side of mining from the standpoint of the fireboss and mine foreman.

The teachers for these two courses should preferably have a good education in mining and some experience in teaching. If, however, such a person is not obtainable, the teacher or teachers selected should be enrolled in a State Teacher Training Course to receive instruction in the technical information outlined in the courses as well as methods of teaching.

Each teacher, in order to teach an approved public evening mining class, must have a state certificate entitling him to teach such a class. The certificates are granted in accordance with the State regulations which are approved by the Federal Board for Vocational Education.

Teachers who desire to be certified for this work should apply to the Teacher Bnreau, Department of Public Instruction, Harrisburg, Pa.

WHEN EVENING MINING CLASSES MAY BE HELD

Classes in mining such as are described in this bulletin may be classified as evening classes if they are conducted at anytime outside of the working hours of the men. Such an interpretation gives a very broad range of time in which these classes may be conducted. A time which will be most convenient to the men should be selected. The classes may be held on any day of the week except Sunday.

LENGTH OF EVENING MINING COURSES

Classes may begin sometime between October first and November first. They will usually close not later than April first. On this basis it will be possible to have classes during a period of from twenty to twenty-four weeks and at the same time observe all the regular school holidays.

The courses in "English for Evening Classes in Bituminous Coal Mining" and "Arithmetic for Evening Classes in Bituminous Coal Mining" should be given previous to the course for firebosses. If the work is given previous to the firebosses course, the classes may meet two evenings per week—English for one-half hour per evening and arithmetic for one and one-half hours per evening. By this intensive method, the work may be finished in five weeks.

The course entitled "Evening Course for Firebosses in Bituminous Coal Mines" may be completed in thirty sessions of two hours each. On this basis if the classes have two sessions per week, fifteen weeks of work should complete the course.

The "Evening Course for Mine Foremen and Assistant Mine Foremen" is divided into two parts and was so divided to cover two years of instruction of sixty hours the first year and sixty hours the second year. On the basis of two hour sessions and two sessions per week, the first year course can be given in fifteen weeks and the second year course in fifteen weeks.

The following program is given to illustrate how the classes may be scheduled:

COURSES AND TIME

Day and Date	English Half hour sessions	Arithmetic One & one-half hour sessions	Fireboss Two hour sessions	Mine Foremen I Two hour sessions	Mine Foremen II Two hour sessions
Mon. Oct. 10	Correspondence	Whole numbers			
Thurs. Oct. 13	Correspondence	Numbers other than whole numbers			
Mon. Oct. 17	Spelling	Numbers other than whole numbers			
Thurs. Oct. 20	Spelling	Simple Proportion			
Mon. Oct. 24	Spelling	Involution & Evolution			
Thurs. Oct. 27	Spelling	Involution & Evolution			
Mon. Oct. 31	Reports	Mensuration			
Thurs. Nov. 3	Reports	Mensuration			
Mon. Nov. 7	Examinations	Formulas			
Thurs. Nov. 10	Examinations	Angles & Rt. A. S.			
Mon. Nov. 14			Mining Law	Mining Law Coal and its origin	Ventilation
Thurs. Nov. 17			Gases	Coal and its origin. Ventilation	Ventilation
Mon. Nov. 21			Gases	Ventilation	Ventilation .
Thurs. Dec. 1			Gases	Ventilation	Securing Workings
Mon. Dec. 5			Gases	Ventilation	Drainage
Thurs. Dec. 8			Gases	Ventilation	Explosives Accident prevention
Mon. Dec. 12			Gases	Ventilation	Hoisting
Thurs. Dec. 15			Gases	Ventilation	Hoisting
Thurs. Jan. 5			Gases	Ventilation Min. Law	Hoisting
Mon. Jan. 9			Gases	Methods of work	Hoisting
Thurs. Jan. 12			Gases	Methods of work	Hoisting
Mon. Jan. 16			Gases	Methods of work	Haulage

Day and Date	English Half hour sessions	Arithmetic One & one-half hour sessions	Firehoss Two hour sessions	Mine Foremen I Two hour sessions	Mine Foremen II Two hour sessions
Thurs. Jan. 19			Mining Law	Min. Law Securing Workings	Haulage
Mon. Jan. 23			Safety Lamps	Securing Workings	Haulage
Thurs. Jan. 26			Safety Lamps	Securing Workings	Haulage
Mon. Jan. 30			Safety Lamps	Securing Workings	Haulage Min. Law
Thurs. Feb. 2			Safety Lamps	Securing Workings Min. Law	Shaft Sinking
Mon. Feb. 6			Mining Law	Drainage	Shaft Sinking
Thurs. Feb. 9			Accident Prev.	Drainage	Min. Law Electricity
Mon. Feb. 13			Accident Prev.	Drainage	Electricity
Thurs. Feb. 16			Accident Prev.	Drainage	Electricity
Mon. Feb. 20			First Aid	Min. Law Explosives	Electricity
Thurs. Feb. 23			First Aid	Explo-sives	Electricity
Mon. Feb. 27			First Aid	Explo-sives Min. Law	Electricity Min. Law
Thurs. Mar. 2			Review	Accident Prev.	Safety Stand
Mon. Mar. 6			Review	Accident Prev.	Safety Stand
Thurs. Mar. 9			Review	Review	Review
Mon. Mar. 13			Review	Review	Review
Thurs. Mar. 16			Review	Review	Review
Mon. Mar. 20			Exami-nations	Exami-nations	Exami-nations

While definite divisions in regard to time have been given and certain suggestions in regard to the administration of the courses have been made, it should be remembered that the main object to be accomplished is the proper presentation of the subject matter outlined. If this end can be accomplished in less time or if a different plan of work seems more feasible for any given community, the school authorities and teachers should not hesitate to make the proper adjustments, subject to the approval of the State Superintendent of Public Instruction. It should be borne in mind that the degree of accomplishment on the part of the students is the final test of the success of the classes.

SIZE OF CLASSES

The minimum number of students which will ordinarily be accepted by the State Department, as an approved class, is ten. The maximum number of students which any one teacher should teach at the same time is twenty-five.

More pupils than this in one class makes individual instruction very difficult.

Any deviation from the minimum size of class will prevent its approval by the State, unless the State Superintendent of Public Instruction, after careful consideration of the facts of the case, finds that the non-approval of the class would harm the service of the public schools to the people of the community. In such cases schools may be approved for a limited time.

NO TUITION MAY BE CHARGED FOR INSTRUCTION IN PUBLIC EVENING MINING CLASSES

Under the school code no tuition may be charged for the instruction given in public evening mining classes. The teachers are paid by the school district (see section entitled "State Aid") from the school treasury. The school district furnishes all buildings, equipment, supplies, books, heat, janitor service, etc., which are needed for the successful operation of the classes.

STATE AND FEDERAL AID

State and Federal money is available for reimbursement in part for the expense of operation of public evening mining schools and classes which are approved by the State Superintendent of Public Instruction. Two-thirds of the salaries of teachers in these classes may be reimbursed from State and Federal funds.

In cases where a sufficient number of evening vocational classes are operated, in either mining or other subjects, a special supervisor may be employed for the work. The State may reimburse the school district to the extent of two-thirds of the salary of such supervisor. In all cases, however, the need for special instruction must be evident and approved by the State Superintendent of Public Instruction before reimbursement will be given.

ASSISTANCE FROM THE STATE DEPARTMENT

School districts which are operating evening mining classes, or which contemplate the establishment of such classes, are requested to communicate with the State Superintendent of Public Instruction, Harrisburg, Pennsylvania.

The State Department of Public Instruction desires to cooperate with and be of assistance to all public school districts, citizens or groups of citizens within the Commonwealth who are interested in the premotion of public evening schools.

For additional information covering methods of supervision, approval, aid, etc., address the State Superintendent of Public Instruction, Harrisburg, Pa.

COOPERATION WITH MINING INTERESTS

Generally speaking, school people should cooperate with all worthy agencies promoting and conducting evening classes which lead to preparation for official positions in the mines.

In any given community it pays to get the support of the persons who will be most interested in the development of classes. Thus the officials of the various coal companies, if they believe in the work and give it their active support, will assist greatly in securing men for the classes and making the instruction beneficial.

The State Mine Inspectors are close to the situations in their respective districts. Their influence will be found very helpful in securing men for the classes and their services might well be utilized in making the instruction more effective from year to year.

All community interests which may be made helpful in making the work of the mining classes more successful and beneficial should be utilized.

FINAL PUBLIC SCHOOL EXAMINATION AND CERTIFICATE

At the end of the "Evening Course for Fire Bosses in Bituminous Coal Mines" or the "Evening Course for Mine Foremen in Bituminous Coal Mines" a final examination should be given in the work completed.

The examinations may be in charge of a Local Examining Board appointed by the board of school directors. The superintendent or the supervising principal of schools should be chairman of this local board. Two other members should be appointed from local mines. Neither of the local examining board members should be selected from the state examining board, nor should the teacher or teachers of the class or classes be chosen, nor should any member of the board be of less grade officially in the mines than the position for which the course prepares.

The duties of the Local Examining Board shall be to prepare the questions for examination. The Board shall also conduct the examination and correct the papers.

Those who complete either of the mine official's courses outlined in this bulletin should be granted a certificate of accomplishment by the Board of School Directors. This certificate is issued by the school board and does not in any way render unnecessary the taking of the State examinations for officials which is given in accordance with the State Mining Law.

No. .... 19.....

COMMONWEALTH OF PENNSYLVANIA

SCHOOL DISTRICT OF CONNELLSVILLE

MINING CERTIFICATE

This certifies that.....has completed the

.....

as prescribed by the State Department of Public Instruction. He has satisfactorily met all of the requirements of scholarship in the following units of the course: .....

.....

.....

.....

Chairman, Local Examining Board Pres., Board of School Directors

GENERAL SUGGESTIONS FOR TEACHERS OF EVENING MINING CLASSES

Characteristics of the Most Successful Teacher of Mining Classes:

1. He is a man who is respected by the men in his class.
2. He is a man who dispenses with unnecessary formalities. He realizes that he is teaching *men* each of whom has a definite purpose in mind. He has the confidence of the members of his class. He makes the men feel at home in the class by encouraging an atmosphere of democracy.
3. He knows mining and possesses a sincere desire to have others know as much or more than he does. He keeps nothing back which will help the men in their work. He is enthusiastic about his teaching work.
4. He plans his work carefully, keeping in mind the course outline and the particular needs of his men. He is prepared for every lesson and by making a lesson outline knows exactly what material he will present each time. He is always a step in advance of his class in his thinking.
5. In making his lesson assignment he is very sure that each member of the class understands exactly what to prepare for the succeeding lesson. He makes certain that the men know where to find the material for study.
6. He guides the class carefully in the preparation of every lesson. He shows the class how to study the assignment and impresses the importance of studying thoroughly the material which has been assigned.
7. During the class period he plans for a proper distribution of time between class discussion, problem work, class recitation, lesson assignment and explanation. He keeps the work of the class on the subject of the lesson by a diplomatic exclusion of irrelevant material. He treats each lesson according to its particular requirements. The amount of instruction given on a subject is dependent upon its relative importance to the needs of the men.
8. He makes it possible for members of the class to obtain all necessary reference and text material for successful home study and class work.
9. He makes each member of the class feel a responsibility for a definite part of the work of the class. Aside from the regular work of the class, each member, when possible is made responsible for a special contribution to the development of a lesson. The subject is selected because of the

special value and interest it will bring to the work of the class and the assignment to the individual will be made on the basis of particular interest or experiences.

10. He utilizes the test examinations given during the course for the purpose of having the members of the class discover their weak points and encourages and assists them in strengthening their deficiencies so disclosed.

Miscellaneous Suggestions for the Teacher:

1. It will be wise for the teacher to study the suggestive reference material given for each subject of the courses, as well as other printed matter of which he may have information. He should make a list of the text material which will be of assistance to the class.

The list of texts ought to be made on the basis of the needs of each member of the class; each individual should have text material for his use during the courses and for his reference after the courses are completed. (The series of Bulletins on Mining issued by the Federal Board for Vocational Education, should not be overlooked when selecting this list.) Pamphlets on coal mining like those published by the International Text Book Company are valuable material for this purpose. Each man should own a standard handbook on coal mining. There are also a number of handbooks, bulletins, technical papers, and miners circulars, issued by the U. S. Department of Interior, Bureau of Mines, which will add very much to the study material for the men both during the term of the course and at future times. The instructor should take the responsibility of seeing to it that the men procure the necessary study and reference material needed for the class work.

The list of mining books as indicated above should be procured for the school library and should be supplemented by as many additional books and magazines on coal mining as will be beneficial to the class. Coal journals such as the following may be procured:

Coal Age—published by McGraw Hill, New York.
Coal Industry—published by Coal Industry, Pittsburgh.
Coal Trade Bulletin—Published by Coal Trade Bulletin Pittsburgh.

The use of this library by members of the class should be encouraged. When books or pamphlets are loaned, a deposit may be charged to guarantee their return.

2. If it is necessary to have study material for the individual use of the students other than that which may be pro-

cured in printed form, the teacher should prepare it and, through the school district, have it duplicated or mimeographed.

3. The importance of persistent study should be stressed. The class should be made to understand the large amount of valuable information which is available on coal mining and the comparatively small amount which can be learned in a short intensive course. The importance of further study, after the course is completed, should be strongly emphasized.
4. For each subject outlined for the course, a suggestive time limit is given. These suggestions are made in a more or less arbitrary manner and may not always indicate the exact maximum or minimum time allotment needed. The time limits are suggested for the purpose of assisting the instructor in a proper distribution of the time which is available.
5. Copies of the old State examination questions and answers for various official positions in the mines may often be procured from the State Department of Mines, Harrisburg, Pa., or from the Examining Board under whom the men will take the State examination.
6. The instructor should keep in very close touch with the Mine Inspector of his district. Mine inspectors can often render valuable assistance in the work of the class.
7. Students and all people interested in mining should be invited and encouraged to use the school library. Make the school a center to which mining people will want to come.
8. Cooperate with the officials of the local mines. They will be able to help you in improving the quality and effectiveness of your class work.
9. If you need mine apparatus for the temporary use of the class, or if you desire to visit any part of the mine for purposes of study, explain your needs to the mine superintendent and he may be in a position to help you.
10. The Bituminous Mining Laws of Pennsylvania which are referred to in connection with the courses of study are of the edition printed in 1921. A good device for the teacher to use in assisting the men to study the law is to furnish them with a skeleton outline of the law as it applies to each *short unit* on *mining law* as outlined.

The above are simply a few suggestions and are not in any sense to be regarded as being equivalent to the teacher training requirement mentioned in the section of this bulletin entitled "Teachers—Training and Certification."

PART II

ENGLISH FOR EVENING CLASSES IN BITUMINOUS COAL MINING

4 Units—5 Hours

Prerequisites for entrance:

1. Men must be eligible for entrance into either the "Evening Course for Firebosses in Bituminous Coal Mines" or the "Evening Course for Mine Foremen in Bituminous Coal Mines."
2. Men must have a minimum knowledge of reading and writing equivalent to that completed in the sixth grade in school.

Explanatory Note:

This is a short intensive course in English. It is not intended to cover the whole field of the subject but merely to furnish the men with a preliminary knowledge of written English which will make it possible for them to do the work for which they are preparing more effectively. The work should be made most practical and should be limited to the field of mining. A great deal of application of the principles learned in this class will come in the classes for firebosses and mine foremen.

COURSE OUTLINE

Unit	*Subject*	*Topics*
Eng. I	Correspondence (1 Hour)	I. Business Letters a. Heading b. Introductory address c. Salutation d. Body of letter e. Complimentary close f. Outside address

The following examples are illustrative of types of letters which may be used by the teacher in presenting this subject:

450 Main Street,
Johnstown, Pa.
June 30, 1921.

Mr. Thomas Hilliard,
Lilly Company,
Brownsville, Pa.

Dear Sir:

The explanation, contained in your letter of June 26th, relative to the merits of the Pieler Lamp was sufficient for me to make a recommendation to our Superintendent. I assume that it cannot be used as an illuminating lamp. Am I correct?

I thank you for your courteous attention to my request for information.

Very truly yours,
John Grozier.

(Outside address)

John Grozier,
450 Main St.,
Johnstown, Pa.

Mr. Thomas Hilliard
Lilly Company
Brownsville
Pa.

208 Second Avenue
California, Pa.
September 26, 1921.

Department of Interior
Bureau of Mines
Washington, D. C.

Gentlemen:

Please send me the following circulars which are published by your bureau:

Miners' Circular 12. Use and Care of Miners' Safety Lamps, by J. W. Paul.
Miners' Circular 14. Gases found in Coal Mines by G. A. Burrell and F. M. Seibert.
Miners' Circular 21. What a Miner can do to Prevent Explosions of Gas and Coal Dust, by G. S. Rice.
Miners' Circular 23. Elementary First Aid for the Miner, by W. A. Lynott and D. Harrington.

I hope you will give prompt attention to this request.

Very truly yours,
H. V. Bright.

H. V. Bright
208 Second Avenue
California, Pa.

Department of Interior
Bureau of Mines
Washington
D. C.

Method of Procedure:

1. The teacher should stress the importance of letter writing and spoken English.
   (a) Greater responsibility brings necessity for more communication by correspondence and conversation.
   (b) Poorly written English is more noticeable than poorly spoken English.
   (c) A letter is sometimes more satisfactory than conversation because a record can be kept in the form of a carbon copy.
2. The importance of brevity, clearness, neatness and good form in writing letters should be impressed upon the class.
3. The men may be taught the proper form and necessary skill by copying several type letters such as he is likely to use.
4. The men should be encouraged to practice writing letters. They should be impressed with the fact that only by much practice will they become proficient.
5. The following suggestions are examples of what may be done in assigning work to the class:
   a. Rewrite, punctuate, and arrange for letter headings.
   220 highland ave grand haven mich may 3 1920
   55 water st mobile ala june 16 1921
   132 pennsylvania ave washington d c sept 21 1920
   b. Write a letter to a supply house for information concerning a particular thing.
   c. Answer an assumed letter from a mine superintendent asking about your experience and other qualifications in mining.

References for the teacher:

Century Handbook of Writing—Grever & Jones—Century Co.

Handbook of Composition—Wooley—Heath.

Unit	*Subject*	*Topics*

Eng. 2 *Spelling I.* *Words of a general nature used by mining men:*

The following words will be used many times by mining men and are suggestive. Other words may be added:

1.	contract	21.	balance	41.	ownership
2.	collect	22.	anthracite	42.	decision
3.	Wednesday	23.	ambitious	43.	peculiar
4.	finish	24.	mechanical	44.	shoulder
5.	friend	25.	solicitor	45.	salary
6.	built	26.	estimate	46.	imitate
7.	company	27.	management	47.	laborer
8.	oblige	28.	employee	48.	specimen
9.	organization	29.	safety	49.	signature
10.	conference	30.	apparatus	50.	government
11.	piece	31.	acknowledge	51.	railroad
12.	system	32.	foreigner	52.	February
13.	opiniou	33.	compensation	53.	receive
14	certain	34.	natural	54.	distribute
15.	business	35.	patent	55.	progress
16.	describe	36.	accident	56.	possible
17.	their	37.	receipt	57.	necessary
18.	familiar	38.	inspector	58.	investigate
19.	often	39.	weather	59.	raise
20.	develop	40.	machine	60.	trouble

II. *Technical words used in mining:*

The following list is suggestive of technical words which will be used frequently by these men. Other words should be obtained:

1.	ventilation	21.	superintendent	41.	specific gravity
2.	barometer	22.	chemical	42.	tourniquet
3.	thermometer	23.	luminous	43.	bandaging
4.	anemometer	24.	gaseous	44.	iodine
5.	hygrometer	25.	gauze	45.	examinations
6.	psychometer	26.	safety lamp	46.	cribbing
7.	humidity	27.	igniter	47.	wedging
8.	calculations	28.	asbestos	48.	timbering
9.	perimeter	29.	adjuster	49.	dynamite
10.	Fahrenheit	30.	candle power	50.	detonators
11.	Centigrade	31.	filament	51.	haulage
12.	oxygen	32.	nitrogen	52.	siphon
13.	formula	33.	carbon dioxide	53.	reciprocating pump
14.	gauge	34.	methane	54.	atmosphere
15.	velocity	35.	hydrogen	55.	anticline
16.	saturated	36.	acetylene	56.	disintegration
17.	current	37.	black damp	57.	geology
18.	haulage	38.	carbon monoxide	58.	chutes
19.	temperature	39.	combustion	59.	crusher
20.	explosive	40.	oxidation	60.	hituminous

Method and Procedure:

1. The importance of good spelling, as it will affect letters and reports written by mine officials, should be stressed by the teacher.
2. The men should be encouraged to write in a note book all words which they frequently misspell throughout the course.
3. Men should be encouraged to use the dictionary. There should always be a good one available for the use of the class. The use of the encyclopedia should also be a part of the work of this class. The meaning of words studied should be known to each member of the class. Assignments of words which are to be looked up in the dictionary should be made to the men.

References:

Any standard dictionary may be used.

Bituminous Mining Laws of Pennsylvania may be used to get additional mining words.

Unit	*Subject*	*Topics*
Eng. 3	**Reports (1 hour)**	I. Reports made on forms
		II. Recommendations
		The following examples of actual reports illustrate what can be done in studying report making:

EXAMPLE I

FIRE BOSS REPORT of daily first inspection of Mineola No. 3 Mine, District No. 6 of the bituminous coal region of Pennsylvania as required by article 5 of the Act of Assembly, June 9, 1921.

DATE		EXPLOSIVE GAS	
1921	FOUND IN ROOMS NOS.	Location of Rooms in Entries Nos.	Found in Entries Nos.
9-23	4 and 7	West Main	
		A. C.	

DANGER FROM FALLS OF SLATE, ROOF AND SIDES

FOUND IN ROOMS NOS.	Location of Rooms in Entries Nos.	Found in Entries Nos.
No. 2 Bad slate on roof	East Main Hdg.	

State nature and location of any other danger found in any place in the mine.	Did you examine for all dangers in all portions of mine under your charge?	Is the mine in safe condition for the men to enter?
None	Yes (or No)	Yes (or No)

GENERAL REMARKS	Time taken in making examination (Hours)	Signature of Fire Boss and Mine Foreman (For each day)
Places mentioned	4 to 7 A.M.	James Williams
Dangered off		John Doe

EXAMPLE II

MINE FOREMAN'S REPORT of Mineola No. 3 Mine, District No. 6, of the Bituminous Coal Region of Pennsylvania, as required by Act of Assembly, approved June 9, 1911, for month of August, 1921

DATE 1921	State from your personal observation during the day the condition of the mine as to health and safety. Have the dangers reported to you been removed?
	I have today visited and examined all working places in Mineola No. 3 mine, and found all in a practically safe and lawful condition at the time of my visits, except the following places dangered off by the fire boss, and reported by him in the State record book: Nos. 4 and 7 Rooms—off West Main Aircourse (Explosive gas) and No. 2 Room East Main Hdg—Dangerous slate on roof of face. These dangers received prompt attention, were removed, and made safe for the men to go to work. The provisions of the law have been complied with in regard to health and safety.

State whether or not there was a proper supply of materials on hand for the safe working of the mine.	Signature of Mine Foreman for each day and of Superintendent for each week.
Sufficient supplies on	John Doe
hand for the safe working of the mine.	
	Wm. Roberts, Supt.

EXAMPLE III

MINE FOREMAN'S REPORT of Weekly Air Measurements in Mineola No. 3 Mine, District No. 6, of the Bituminous Coal Region of Pennsylvania, as required by Act of Assembly, approved June 9, 1911, for the month of November 1921.

DATE	Name or number of entry or name or number of split.	Area of entry in feet	Velocity of air per minute.	Cubic feet of air passing per minute.	No. employed in split.
	No. 1 split West Main Section.				
	Main Intake	50	420	21,000	
	West Main Hdg.	60	240	14,400	27 Day
	West Main Air Course	50	260	13,000	
11-23	1st Right Hdg.	50	180	9,000	8 Night
	2nd Right Hdg.	50	190	9,500	
	Return 4 Right	60	340	20,400	

Area of cut through in room in feet	Cubic Feet of air passing per minute	Number of revolutions of fan	Water gauge in inches	No. Cubic Ft. of air per min. entering at inlet.	No. cubic feet of air at outlet
35	35 x 400=	270	2"	21,000	20,400
	14,000				

Method and Procedure:

1. The importance of reports may be readily impressed on the students by the fact that they are often required by law, are sometimes used as evidence in damage suits, and as a basis for judging a man's fitness for promotion.

2. Emphasis should be placed on quality of writing, capitals, spelling, neatness and punctuation.

3. Encourage students to read each others reports and correct them for English.

4. The following suggestive subjects are given for report on forms:
   a. Gas in a section that you drove out.
   b. A case where you had to brattice.
   c. A bad roof.
   d. A fall during the night.
   e. Lack of air in a certain entry.
   f. A dangerous place marked off.

5. The following are recommended as typical of subjects which may be assigned for recommendations to the mine superintendent or mine foreman:
   a. Recommend a certain safety lamp.
   b. That a section be permanently discontinued.
   e. That a better method of posting be used in a certain place, etc., etc.

Unit	*Subject*	*Topics*
Eng. 4	*Examinations* (1 hour)	I. Form in answering examinations. II. Good writing and punctuation in examinations. III. Spelling and neatness in examinations.

The following examples illustrate good form in answering examinations.

I.

Q. What is carbon dioxide and where does it come from?

A. "Carbon dioxide is a gas formed from a chemical combination of one part carbon with two parts oxygen. In coal mines, this gas is escaping continuously from the pores of the coal as entries and rooms are driven, and the coal broken down. It is also formed by the breathing of men and animals, by the burning of lights and is always present in large proportions in the fumes of explosives."

II.

Q. How do you determine the quantity of air passing an airway?

A. "In order to find the quantity of air passing, it is necessary to get the correct velocity with an anemometer for a certain length of time. This is done by taking readings in four or five places in the same cross section, center, sides, top, bottom, adding them together, and dividing the sum by the number of readings taken. This average velocity is multiplied by the area of the cross section. Expressed in a formula:

$Q = av$

Q stands for quantity in cubic feet per minute.
a stands for area in square feet (height x width)
v stands for velocity in feet per minute."

III

Q. Describe the best method of posting?

A. "A method of posting cannot be given for general use as one system rarely fits two mines. Any system should afford a safe means of exit or retreat from the working face to the heading."

IV

Q. What are the duties of a fire boss?

A. "The duties of a fire boss are to examine all working places before the men enter the mine, and such examinations shall be commenced not more than three hours prior to starting time. An examination is made for gas and for dangerous roof conditions; also to see that ventilation is normal, the proper amount of air in circulation and traveling its proper course. Any dangerous place is marked off and no one allowed to enter until it has been made safe. A record of each dangerous place must be entered in a record book at the mine office."

Method and Procedure:

1. Written answers to questions should be practiced by men who expect to take examinations. A few simple rules such as the following may help:
   a. Read the question thoroughly and meditate. Try to understand it fully.
   b. Write the answer briefly according to a prescribed form.
   c. Read your answer and correct mistakes.
2. In studying the illustrative questions and answers the following suggestive methods are given:
   a. Which question is most completely answered?
   b. What do you think of No. III?
   c. Would Q = av have been sufficient answer for No. II?
   d. Answer the following questions:
      a. If nitrogen is not a poisonous gas, why can a man not live in an atmosphere of pure nitrogen?
      b. Name some of the methods of piling mine props. Which is the best method?
      c. How is the proportion of gas present in normal air determined by a miner's safety lamp?
   e. Examine lists of questions from former examinations.
   f. Practice writing answers to questions. Rewrite your remembrance of a text book subject, or your instructor's talk.

PART III

Arithmetic for Evening Classes in Bituminous Coal Mining
7 Units—15 Hours

Prerequisites for entrance:

1. Men must be eligible for entrance into either the Evening Course for Firebosses in Bituminous Coal Mines or the Evening Course for Mine Foremen in Bituminous Coal Mines.
2. Men must have a minimum knowledge of fundamental operations with whole numbers.

Explanatory note:

Due to the fact that this is a short intensive course in arithmetic it will not be possible or desirable to devote much time to drill on abstract problems. Practice on the principles and processes should be had by means of problem work demonstrating actual conditions to be found in and around the mines. The mathematical processes learned in this course will be applied again in problems given in the courses for firebosses and mine foremen.

For the first unit a number of illustrations will be given showing the type of problems which may be used to furnish practice in fundamental operations with whole numbers. In units which follow unit number one, not so many illustrations are given, but the teacher should nevertheless use a variety of mining problems to teach the processes indicated.

Suggestive problems may be found in many of the reference books listed in the courses for firebosses and mine foremen.

Course Outline

Unit	*Subject*	*Topics*
Arith. 1	*Whole numbers* (1½ hours)	1. Fundamental operations with numbers limited to those likely to be met in practice. A. Addition B. Subtraction C. Multiplication D. Division The problems which follow are illustrative of the type which may be used in reviewing the above topics. Other problems will be supplied by the teacher.

Addition:

1. Five cars loaded with coal have weights as follows: 3701, 3812, 3694, 3680 and 3562 pounds. What is the total weight of the train?

Subtraction:

1. If five cars loaded with coal weigh 18,498 pounds, and the weight of the empty cars is 5,250 pounds, what is the total weight of the coal contained in them?

Multiplication:

1. Mine rails are 18 feet long. One side of a track has 586 rails. How long is the track?
2. An airway is 5 ft. high and 7ft. wide. What is its cross sectional area?

Division:

1. If 16 carloads of coal weigh 46,336 pounds, what is the average weight per carload?
2. A mine pump delivers 52,848 gallons of water in 24 hours. What does it deliver each hour?

Multiplication and addition:

Find the rubbing surface of an airway 5 ft. by 6 ft. if it is 225 feet long.

Addition, multiplication and division:

1. A drift is 7 ft. high, 6 ft. wide at the top and 8 ft. wide at the bottom. Find the cross section of the drift.
2. If the drift in problem I is 1456 ft. long, how much material was removed?

Method and Procedure:

1. Teacher should endeavor to teach the class to analyze the problems both from the standpoint of mathematical operations and order to be followed.
2. When problems involving mensuration have been solved, students should be assisted in formulating rules for the solution of similar problems in the future.
3. Considerable practice should be had in solving problems involving combinations of fundamental operations.
4. Teacher should compose additional mining problems for class involving fundamental operations with whole numbers. Make use of the field of mensuration when seeking such problem material.
5. Exactness should be stressed.

Unit	*Subject*	*Topics*
	Numbers other than whole numbers (3 hours)	I. Fundamental operations with common fractions limited to simplest cases as $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{3}{4}$, $\frac{1}{5}$, $\frac{1}{8}$, $\frac{3}{8}$, etc.
		II. Reduction of common fractions to decimals (Use of tables)
		III. Reduction of Fractional parts of mixed numbers to decimals.
		IV. Fundamental operations with decimals.
		V. Percentage.
		The following problems are illustrative of the type which may be used in studying the processes outlined.

Addition:

1. On four successive pay checks a miner receives \$62.80, \$65.75, \$61.10 and \$57.69. Find the total amount of money he received.

Multiplication and percentage:

1. In the above problem the miner pays his laborer 21% of this pay. What does the laborer receive?

Subtraction:

1. A storage bin is 7/8 full of coal. If 4/5 is drawn off, how much is left? (Reduce to Decimals)

Multiplication and division:

1. It is required to build a mine car with a box 1′ 11″ high, and 4′ 2″ wide, just large enough to hold a ton of coal when level full. How long must the box be if there are 25 cu. ft. in a ton of coal.

Method and Procedure:

1. Very little time should be spent on fundamental operations with fractions. The processes should be taught, however, for simple cases as indicated. The names of the parts of fractions should be taught.

2. Reduction of fractions and mixed numbers to decimals should be taught thoroughly. In all of the problems work as indicated above fractional parts should be reduced to decimals when solving.
3. Reduction of fractions to decimals should be taught both by division and by use of tables.

Unit	*Subject*	*Topics*
Arith. 3	*Simple proportion* ($1\frac{1}{2}$ hours)	I. Proportion expressed as equality of two ratios. (ratios expressed as fractions) a. Direct proportion The following problems will illustrate the type which may be used in teaching proportion:

Direct proportion:

1. If a fan delivers 80,000 cu. ft. of air at 60 R.P.M., how much can it deliver at 100 R.P.M?
2. If a mine in which 291 men are employed below ground produces 1760 tons of coal per day, how many tons should be produced in a mine which employs 356 men underground?

Method and Procedure:

1. Fractions should be used to express ratios. In case the two numbers composing the ratios are fractions, those may be reduced to decimals.
2. The idea of equality of two fractions to express a proportion is here introduced. In order to solve for one unknown quantity, the solution of simple equations must be taught.

Unit	*Subject*	*Topics*
Arith. 4	*Involution and Evolution* (3 hours)	I. Squares and cubes of numbers II. Square root and cube root The following problems are illustrative of the type to be used in teaching this work.

Square root of numbers:

1. A ten acre tract of coal land is in the form of a square. Find length of a side.

Cube root of numbers:

1. If a cubical block of coal weighs $3\frac{1}{2}$ tons, what are its dimensions if 25 cu. ft. of coal make a ton?

Method and Procedure:

1. Little practice need be given in the squaring and cubing of numbers. Square root and cube root should be taught thoroughly. Appropriate problems may be found in the field of mining.
2. The use of tables in finding the square root and cube root should be encouraged. (See references for books of tables).

Unit	*Subject*	*Topics*
Arith. 5	*Mensuration* (3 hours)	I. Length of lines A. Distances II. Areas of surfaces and sections A. Triangles, quadrilaterals, circles III. Volumes IV. Weights and measures A. Liquid measure B. Dry measure C. Avoirdupois weight

Method and Procedure:

1. If the proper problems have been used in giving the previous instruction, this work will be a recapitulation of previous work. At this time, the field of mensuration should be reviewed thoroughly and all possible types of problems solved which relate to mining and come in the field of mensuration.

Unit	*Subject*	*Topics*
Arith. 6	*Formulas* ($1\frac{1}{2}$ hours)	1. How formulas are made II. Use of formulas

Method and Procedure:

1. Using the problems of mensuration which have been solved, students should write formulas. Thus in the first illustrative problem under Arith. 1. type problem 2 under multiplication, $a = h \times w$, where a is the sectional area, h is the heighth and w the width of the airway. Similarly for the problem illustrating multiplication and addition in the same

unit the formula could be written S= (2h+2w) 1. Where S is the rubbing surface, h is the heighth, w is the width and 1 is the length of the airway.

2. The value of formulas as short hand statement of rules, and as simplifying the solution of problems should be impressed upon the students.
3. Several problems may be solved without going into details as to the derivation of the formulas.

The following formulae may be utilized for practice:

Q=av

Where Q=the quantity of air passing through an airway in cu. ft. per minute
a=the cross sectional area of the airway
v=the velocity of the air in feet per minute

$$HP=\frac{PLAN}{33000}$$

Where HP=the horse power of a steam engine
P=steam pressure in pounds per square inch
L=length of stroke in feet
A=area of the piston in square inches
N=the number of times the steam is applied to the piston per minute.

Unit	*Subject*	*Topics*
Arith. 7	*Angles and solution of right triangle* ($1\frac{1}{2}$hours)	I. Measure of angles II. Trigonometric functions III. Problems on grades

Method and Procedure:

1. The means by which angles are measured and the unit of measurement should be taught.
2. Sine, cosine and tangent functions should be studied and applied to the solution of right triangles. Problems involving slopes in mines should be solved.
3. Four place tables of natural values of the functions are ample for all the needs of this course.
4. Method of finding per cent of grade should be taught.

References for the teacher:

I. C. S. Mining Textbooks—International Text Book Company, Scranton (5 booklets)
1. Elements of Arithmetic

2. Fractions
3. Decimals
4. Weights and Measures
5. Ratio and Proportion

Practical Mathematics—Palmer—McGraw

Computation Tables and Formulae—Barker—Ginn & Co.

Coal Miner's Pocketbook—McGraw

Constructive Text Book of Practical Mathematics—Vol. 1—Marsh—Wiley

Coal Miner's Handbook—I. C. S.—International Text Book Company

Note: For the purpose of saving time in making computations it is recommended that the student provide himself with a set of computation tables.

PART IV

Evening Course for Firebosses in Bituminous Coal Mines

8 Units—60 Hours

Prerequisites for entrance:

1. Citizen of the United States of America.
2. Good Moral Character.
3. At least eighteen years of age.
4. Working in a coal mine.
5. A satisfactory knowledge of the following subjects:
   Reading
   Writing
   Elementary Arithmetic

Course Outline

Unit	*Subject*	*Topics*
F. B. 1	*Mining Law* (2 hours)	I. Duties of the miner Reference—B. M. L. of Pa. Index p. 185 II. Duties of shot firer Reference—B. M. L. of Pa. Index p. 188 III. Duties of fireboss Reference—B. M. L. of Pa. Index p. 179, 180.

IV. Qualifications of fireboss
Reference—B. M. L. of Pa. Index p. 179.

V. Examining Boards
Reference—B. M. L. of Pa. Index p. 183

VI. Fireboss certificates and fees
Reference—B. M. L. of Pa. Index p. 179.

Method of Procedure:

1. Each student should have copy of Bituminous Mining Law of Pennsylvania. The teacher or students may secure these, free, from Pennsylvania Department of Mines, Harrisburg, Pa.
2. Teacher should make definite assignments of law by paragraph in accordance with outline.
3. Students may read passages from law and teacher should lead in the discussion of their applicability to mining work.
4. Outside preparation should be required. In class the discussion should be kept to the subject.
5. The law should be analyzed by the students. Questions on the law should be prepared by the teacher and answered by the student.

Unit	*Subject*	*Topics*
F. B. 2	*Gases and explosions in mines* (22 hours)	I. Discussion of chemistry as it applies to mining. A. Gases are found in mines B. Gases are formed by Chemical action C. Air is used for ventilation and removal of gases II. Chemical elements—hydrogen, carbon, nitrogen, oxygen and sulphur A. Occurrence in coal mines B. Properties C. Symbols D. Atomic Weights E. Specific Gravity

III. Mechanical Mixtures—Air

A. Use of air in coal mines
B. Properties
C. Composition
D. Effect of temperature on air
E. Effect of pressure on air
F. Weight of a given volume of air
G. Specific gravity of air

IV. Chemical compounds—carbon monoxide (white damp), carbon dioxide (black damp), and carburetted hydrogen, (methane) hydrogen sulphide (stink damp).

A. Formation in coal mines
B. Properties—appearance, smell, taste, inflammability, effect on life.
C. Formulae
D. Molecular weights
E. Specific gravity
F. Diffusion of gases
G. Where found in coal mines
H. How detected in coal mines

V. Study of the atmosphere and gases

A. Atmospheric and gas pressure
B. How to measure pressure—the barometer
C. How to measure temperature—the thermometer
D. Air and gases as fluids—comparison with water

E. Calculating the weight of a given volume of air or gas at given temperature and pressure
F. Effect of change in atmospheric pressure in seams giving off gas

VI. Explosive mixtures

A. Methane and air (fire-damp)—combustion
B. Definition of an explosion
C. Upper "explosive limits"
D. Lower "explosive limits"
E. Ignition temperature
F. Conditions affecting explosibility of "fire damp"
G. How explosions from gas are prevented
H. Gas blowers
I. Calculating cubic feet of flame from exploding gas
J. Calculating quantity of fresh air to be added to prevent a "cap"
K. Calculating quantity of fresh air necessary to dilute gas
L. Calculating time necessary to clear out gas

VII. Coal dust and air

A. How ignited
B. Pressures produced
C. Factors affecting inflammability of coal dust
D. Prevention of dust explosion

VIII. After damp.

A. Composition
B. Effect on life

IX. General principles of mine ventilation

A. Objects of mine ventilation
B. Causes of vitiation of air in mine
C. Methods of supplying air

X. Ventilating Characteristics of force and exhaust fans.

A. Effect of force fans on gases in gobs
B. Effect of exhaust fans on gases in gobs.

Method and Procedure:

1. In presenting this work demonstrations should be made to class of the properties, action etc., of the various elements and gases. While a full equipment for demonstration is not indispensable it is desirable that sufficient be available to produce the gases studied and demonstrate their properties. Some of the equipment may be improvised if necessary.
2. Problems and questions prepared by teacher and students should be thought out and answered by the students. Home study should be encouraged.
3. The teacher should in all cases endeavor to keep the instruction as close to its practical application as possible. With this in mind the demonstration and problem work should be made to apply directly to mining.
4. Specimen problems may be obtained from pamphlets and reference books on the subject.
5. Brief examination should be given in the work of each topic.

References:

Bulletin No. 39—Coal Mine Gases, by A. C. Callen, Federal Board for Vocational Education, Washington, D. C.

Examination Questions and Answers for Mine Foremen, Assistant Mine Foremen and Firebosses, Bituminous Region—Pennsylvania Department of Mines, Harrisburg, Pa.

Physics and Chemistry of Mine Gases and Ventilation—J. J. Walsh,—Van Nostrand.

I. C. S. Mining Textbooks—International Text Book Company, Scranton, Pa. (2 booklets)

1. Properties of Gases
2. Mine Gases

Bulletin No. 41—Coal Mine Ventilation, by R. Z. Virgin, Federal Board for Vocational Education, Washington, D. C.

Coal Miner's Pocketbook—Foster—McGraw

Mine Gases and Ventilation—Beard, J. T.—McGraw

The Investigation of Mine Air—Foster and Holdane

Examination Questions for Certificates of Competency as Mine Inspector, Mine Foreman, Fireboss, etc.—International Text Book Co., Scranton, Pa.

Testing with Safety Lamps—Winstanley—Mines and Minerals, Vol. 30, P. 697.

The following publications of the United States Bureau of Mines, can be obtained by addressing the Director, United States Bureau of Mines, Washington, D. C.

Miner's Circular 14. Gases found in Coal Mines

Miner's Circular 16. Hints on Coal Mine Ventilation.

Miner's Circular 21. What a Miner Can Do to Prevent Explosion of Gas and Coal Dust.

Bulletin 26. Notes on Explosive Mine Gases and Dusts.

Bulletin 72. Concurrence of Explosive Gases in Coal Mines.

Bulletin 74. Gasoline Mine Locomotives in Relation to Safety and Health.

Bulletin 83. The Humidity of Mine Air.

Bulletin 105. Black damp in Mines.

Technical Paper 11. The Use of Mice and Birds for detecting Carbon Monoxide.

Technical Paper 13. Gas Analysis as an Aid in Fighting Mine Fires.

Technical Paper 39. The Inflammable Gases in Mine Air.

Technical Paper 43. The Effect of Inert Gases on Inflammable Gaseous Mixtures.

Technical Paper 122. Effects of Atmospheres Deficient in Oxygen on small animals and Man.

Technical Paper 119. The Limits of Inflammability of Mixtures of Methane and Air.

Technical Paper 134. Explosibility of Gases from Mine Fires.

Technical Paper 150. Limits of Complete Inflammability of Mixtures of Mine Gases and of Industrial Gases with Air.

Technical Paper 190. Methane Accumulations from Interrupted Ventilation.

Unit	*Subject*	*Topics*
F. B. 3	*Mining Law* (2 hours)	I. Mining Law referring to gases and explosions A. Duties of the fireboss in regard to gas accumulations Ref. B. M. L. of Pa. Index P. 179, 180. B. Procedure in cases of dangerous gas accumulation. Ref. B. M. L. of Pa. Index P. 180. C. Special regulations for "Gaseous Mines" Ref. B. M. L. of Pa.—Index P. 180. D. Penalty for neglect of duty by fireboss. Ref. B. M. L. of Pa.—Index P. 186. Ref. B. M. L. of Pa.—Index P. 179. II. Legal requirements with reference to volume of air passing and direction of flow. Ref. B. M. L. of Pa.—Index P. 190.

Method and Procedure:

1. Class work may be oral and written.
2. Class discussion should be encouraged. Discussion leaders may sometimes be chosen from the group.
3. Applications of law should be made whenever possible to real situations familiar to the men.
4. Frequent short written examinations should be given on law. (See State examinations)

Unit	*Subject*	*Topics*
F. B. 4	*Safety Lamps*	I. Use of safety lamps in gaseous mines II. Principle of the flame safety lamp and its construction. A. Function of the wire gauze, shield and other parts of safety lamp.

III. Early types of safety lamp

IV. Various types of flame lamps now in use

V. Method and care in handling safety lamp

VI. U. S. Bureau of Mines requirements for safety lamps

VII. Approved electric lamps for mine use

VIII. The "cap" on the flame of a safety lamp and detection of "fire damp"

IX. Other "fire damp" detectors and their use

Method and Procedure:

1. Types of safety lamps should be available for study and discussion on the part of the class.
2. Construction of the common lamps should be studied most thoroughly.
3. The action of the flame lamp both theoretically and under actual mining conditions should be demonstrated to the class whenever possible.
4. The students should be given an opportunity to become proficient in the manipulation of the safety lamp in general use.
5. Questions based on practical conditions should be studied and answered by the students. Brief examinations should be given by the instructor.

References:

Bulletin No. 42—Safety Lamps, by R. Z. Virgin, Federal Board for Vocational Education, Washington, D. C.

I. C. S. Text Book—Mine Gases (1 pamphlet) International Text Book Co.

Examination Questions for Mine Foremen, Fireboss, etc.,—International Text Book Co.

Mine Gases and Explosions, J. T. Beard.

Publications of the U. S. Bureau of Mines dealing with Safety Lamps:

Bulletin 52. Ignition of mine gases by filament of incandescent electric lamps.

Bulletin 131. Approved electric lamps for miners.

Technical Paper 23. Ignition of mine gas by miniture electric lamps with tungsten filament.

Technical Paper 28. Ignition of mine gas by standard incandescent lamps.

Technical Paper 47. Portable electric mine lamps.

Technical Paper 75. Permissible electric lamp for miners.

Miners' Circular 12. The use and care of miners' safety lamps.

To obtain publications of the U. S. Bureau of Mines address The Director, U. S. Bureau of Mines, Washington, D. C.

Unit	*Subject*	*Topics*
F. B. 5	*Mining Law* (9 hours)	I. All law relating to safety lamps.
		II. Examinations of working places with safety lamps. Ref. B. M. L. of Pa.—Index p. 191.
		III. Open lamps prohibited in certain mines. Ref. B. M. L. of Pa. Index p. 186.
		IV. Safety lamps and precautions in their use. Ref. B. M. L. of Pa. Index P. 188.
		V. Lamp stations. Ref. B. M. L. of Pa. Index 181.
		VI. Electric relighting of safety lamps. Ref. B. M. L. of Pa. Index P. 178.
		VII. Oil for safety lamps.—Ref. B. M. L. of Pa. Index P. 185.
		VIII. Approved electric lamps for mine use. Ref. B. M. L. of Pa. Index P. 178.

IX. Matches prohibited in certain mines. Ref. B. M. L. of Pa. Index P. 182.

X. Smokers' articles forbidden in certain mines. Ref. B. M. L. of Pa. Index P. 189.

Method and Procedure:

I. Same general teaching method should be used here as in previous units on law.

II. Brief examinations should be given covering the various topics of law. (See State examinations)

Unit	*Subject*	*Topics*
F. B. 6	*Accident Prevention* (6 hours)	I. Rules of safety.
		II. Safety block and safety switches
		III. Safety catches.
		IV. Safety devices to prevent over winding.
		V. Safety gates.
		VI. Methods of determining safe or unsafe condition of roof.
		VII. Methods of supporting roof at the working face.

Method and Procedure:

1. Study should be limited to those topics indicated in the outline.
2. As far as possible the methods and standards should be studied from the standpoints of the mines in which the students are working.
3. The class should discuss the topics, section by section, and members should be asked to recite orally on the points covered.
4. Short written examinations should be given based on the subjects and the State Examinations for Firebosses.

References:

Bituminous Mining Law of Pennsylvania—Index pp 187, 188.

Unit	*Subject*	*Topics*
F. B. 7.	*First Aid* (6 Hrs.)	I. Legal requirements in Pennsylvania, Gaseous Mines. Ref. B. M. L. of Pa..— Index p. 180, 181. II. First Aid instructions for coal miners. A. General directions for "first aid man." B. What a "first aid man" should do. C. First Aid "don'ts" D. Resuscitation from asphyxiation, etc. E. Hemorrhage or bleeding. F. Some of most common dressings for wounds and bleeding. G. Fractures-Broken bones. H. First aid treatment of strains, sprains, dislocations, burns. III. "Rescue and Recovery Operations in Mines after Fires and Explosions." Handbook published by Department of Interior, Bureau of Mines, Washington, D. C.

Method and Procedure:

1. The legal requirements for Pennsylvania and first aid instruction should be studied thoroughly by the class.
2. Only that part of first aid need be studied which is outlined above.
3. In addition to study of printed material on first aid, class demonstrations should be given in first aid treatment under the direction of a competent person.
4. Members of the class should be encouraged to practice the most common first aid operations.
5. Rescue and recovery operations should be read and briefly discussed in class.

References on First Aid:

Elementary First Aid for the Miner—Lynott and Harrington —Miners Circular 23, U. S. Department of Interior, Bureau of Mines, Washington, D. C.

Advanced First Aid for Miners—Handbook, U. S. Department of Interior, Bureau of Mines, Washington, D. C.

First Aid to the Injured—I. C. S. Mining Text Book—International Text Book Co., Scranton, Pa.

Resuscitation from Gas Asphyxiation, Drowning and Electric Shock. Department of Interior, Bureau of Mines, Washington, D. C.

Unit	*Subject*	*Topics*
F. B. 8	*Review* (10 hours)	I. F. B. 1. Mining Law
		II. F. B. 3. Chemistry of gases in explosions in mines
		III. F. B. 4. Mining Law
		IV. F. B. 5. Safety Lamps
		V. F. B. 6. Mining Law
		VI. F. B. 7. Accident Prevention
		VII. F. B. 8. First Aid

Method and Procedure:

1. The review should take the form of questions and problems relating to the various units covered.
2. Old examination questions may be utilized by the teacher in obtaining and classifying the review work for the class.
3. Home work is indispensable at this point. The teacher should prepare special questions and problems to guide the members of the class in their home study. Part of the class period should be used in clearing up points of difficulty.
4. Brief examinations should be given after review of each unit. The examination questions should closely approximate those given by the State Department of Mines in past examinations for firebosses.

FINAL EXAMINATION

The examination should cover all of the work given throughout the course. It should be given under the direction of the Local Examining Board described previously.

PART V

EVENING COURSE FOR MINE FOREMEN IN BITUMINOUS COAL MINES

Part I—First Year

14 Units—60 Hours

Prerequisites for entrance:

1. Citizens of the United States.
2. Good moral character.
3. At least eighteen years of age.
4. Working in a coal mine.
5. A satisfactory knowledge of the following subjects as they are outlined in the previous courses:

   Reading and writing
   Elementary arithmetic
   Elementary chemistry of gases
   Safety lamps
   Accident prevention in mines
   First aid
   Mining Law

COURSE OUTLINE

Unit	*Subject*	*Topics*
M. F. 1	*Mining Law* (1 hour)	I. The Mine Foreman and Assistant Mine Foreman and their duties. Ref. B. M. L. of Pa.—Index pp. 175, 182.
		II. Manner in which Mine Foremen and Assistant Mine Foremen are selected. Ref. B. M. L. of Pa. Index p. 182.
		III. Distinction between first grade and second grade mine foremen. Ref. B. M. L. of Pa. Index p. 182.
		IV. State Examinations.

Method of Procedure:

1. Each student, as in the fire bosses course, should have a copy of the Bituminous Mining Law of Pennsylvania.
2. The law should be studied in accordance with the outline, both at home and in class, definite assignments to be made by the teacher.
3. Class discussion of the law as it applies to local mining practice should be encouraged.
4. Brief examinations should be given based on State examinations.

Unit	*Subject*	*Topics*
M. F. 2	*Coal and its origin* (2 hours)	I. Formation of coal. II. Classification of coal III. Characteristics of coal IV. Geological location of various coal seams in the upper and lower bituminous coal measures of Pennsylvania. V. Method of collecting coal samples. VI. Specific gravity of coal. VII. Calculating the weight of coal having given the area and thickness A. Approximate weight of coal per inch in thickness per acre.

Method and Procedure:

1. The formation of coal, etc., should be studied outside of class and discussed very briefly in class. Definite assignments should be made to members of class and each student should have the material for home study.
2. Problem work in calculating weight of coal should be taught and practiced very thoroughly.
3. A brief examination should be given on the essential points covered.

References:

I. C. S. Mining Text Books, International Text Book Co., Scranton, Pa. (2 booklets)

1. Geology of coal
2. Examination of coal properties

Coal and Coal mines—Greene—Houghton

A story of a Piece of Coal—Martin—Appleton

Coal and Coal Mining—Smyth—Van Nostrand

Story of American Coals—Nicolls—Lippincott

Coal, its Origin, Methods of Working—Wilson—Pitman

Coal—Moore—Wiley & Sons

Coal Manual—Wadleigh—National Coal Mining News, Cincinnati, Ohio

Unit	*Subject*	*Topics*
M. F. 3	*Ventilation* (16 hrs.)	I. General Principles of mine ventilation. A. Object of ventilation in mines B. Causes of vitiation of air in mines C. Quantity of air required to properly ventilate 1. Legal requirements D. Velocity of air in shafts and roadways 1. Legal requirements II. Air currents A. Pressure and its relation to direction of flow B. Velocity III. Measuring instruments A. Anemometer—velocity of air B. Water gauge—pressure of air C. Hygrometer and psychrometer—humidity

IV. Calculations

A. Volume of air passing in cu. ft. per minute

1. Area of airway in square feet
2. Velocity of air in ft. per minute

B. Ventilating pressure

1. Pressure of air in pounds per sq. ft.
2. Area of airway in square feet

C. Resistance to the passage of air

1. Coefficient of friction
2. Rubbing surface
3. Velocity of air in feet per min.

D. Horse power of ventilation

1. Ventilating pressure
2. Velocity of air in ft. per min
3. Unit of horsepower
4. Relation of ventilating pressure to resistance to passage of air
5. Relation of horsepower of ventilation to length of airway and pressure

V. Airways and the control of ventilating current

A. Types of airways
1. Map study

B. Stoppings.

C. Doors

D. Brattice

E. Curtains or checkers

F. Overcasts

G. Regulators

VI. Splitting the air current
   A. Advantages of splitting
   B. Limitations to air splitting
   C. Calculating quantity of air passing into splits

VII. Practice in coursing air

VIII. Types of mine ventilation
   A. Natural Ventilation
      1. The "Downcast Column"—The "Upcast Column'
         a. Relative sizes
         b. "Motive column"
      2. Temperature and humidity as they affect natural ventilation
   B. Artificial ventilation
      1. Furnace ventilation
         a. General principle
         b. Power of furnace ventilation
      2. Mechanical ventilation
         a. Blower and exhaust fans
         b. Types of fans
         c. Arrangement of fans

Method and Procedure:

1. Students should be provided with reading material covering the general principles of ventilation in mines. Class discussions of the ventilating systems in the local mines as well as those described in available instruction material should be encouraged.
2. Measuring instruments used in the mines should be available for the class instruction. Demonstrations should be given of their action.
3. Problem work on the calculation of ventilation should constitute a large part of the home work throughout the course.

4. Considerable practice should be given in the coursing of air with use of maps which represent mining operations.
5. Brief written examinations should be given on the topics covered. State examinations will suggest questions and problems on ventilation.

Reference:

Bulletin 41—Coal Mine Ventilation, by R. Z. Virgin—Federal Board for Vocational Education, Washington, D. C.

I. C. S. Mining Text-Book—Mine Ventilation (1 booklet) International Text Book Co., Scranton, Pa.

Mine Gases and Ventilation—Beard—McGraw.

Coal Miners Handbook—I. C. S.—International Text Bk. Co.

Coal Miners Pocketbook—Foster—McGraw

The following miner's circular may be procured from the Department of Interior, Bureau of Mines,Washington, D. C:

Miners' Circular No. 16—Hints on Coal Mine Ventilation—J. J. Rutledge.

Unit	*Subject*	*Topics*
M. F. 4	*Mining Law* (1 hour)	I. Law relating to Ventilation as contained in B. M. L. of Pa.—Index p. 190

Method and Procedure:

1. Home reading assignments to be made in accordance with titles given in index.
2. Class discussions should be based on local conditions.
3. Brief examinations should be given on topics covered.

Unit	*Subject*	*Topics*
M. F. 5	*Methods of Work* (6 hours)	I. "Long wall" Method of mining A. Description B. Seams adapted to this method II.. "Room and pillar" Method of mining A. Description B. Seams adapted to this method

III. Other methods of mining
  A. Brief description
  B. Kind of seams requiring special methods
IV. Faults in coal seams
  A. Causes
  B. Driving rock tunnels through "faults"
V. Pillars
  A. Strength and shape
  B. Calculating shaft pillar size
  C. Calculating ordinary pillar size
  D. Percentage of coal left in pillars
  E. "Robbing pillars'
VI. Driving toward abandoned workings
VII. Effect of the subsidence of the overlying strata, both inside and on the surface

Methods and Procedure:

1. Different methods for underground working should be studied by class at home and discussions of their application should be engaged in during the class session.
2. Problems in calculating size, strength, etc., of pillars should be solved by class.
3. A brief examination should be given on the topics studied.

References:

I. C. S. Mining Textbooks—Methods of Working (4 parts, pamphlet form)—International Text Book Co., Scranton, Pa.

Coal Miners' Pocketbook—Foster—McGraw.

Coal Miners' Handbook—I. C. S.—International Text Book Co., Scranton, Pa.

Unit	*Subject*	*Topics*
M. F. 6	*Mining Law* (1 hour).	I. Laws relating to Methods of Work. Rule 18 of General Rules Ref. B. M. L. of Pa. Index p. 187

II. Barrier pillars
Ref. B. M. L. of Pa.
Index p. 175

III. Blasting
Ref. B. M. L. of Pa.
Index p. 176

IV. Shafts, slopes, drifts, openings and outlets
Ref. B. M. L. of Pa.
Index pp. 178, 186, 188

Method and Procedure:

1. The instructor should definitely assign the parts of the mining law which apply to Methods of Work so that the students may lose no time in finding the part of the law referred to.
2. Reading of law should be done at home. The classroom time should be utilized for discussion and recitation.
3. A brief examination should be given on this work.

Unit	*Subject*	*Topics*
M. F. 7	*Securing underground workings* (8 hours)	I. Securing the shaft II. Securing the shaft bottom III. Securing the main roadways IV. Securing the working places V. Methods of determining safe or unsafe condition of roof VI. Timbering A. Proper inclination in setting props and caps B. Methods used in case of bad roof, good floor and sides C. Methods used in case of bad roof, sides and good floor D. Methods used in case of bad roof, sides and good floor E. "Cribs" or "chocks" F. Lagging, notches and double timbers

G. Advantages of systematic timbering in working places

VII. Decay and preservation of timbers

VIII. Brick work

A. Sidewalls
B. Arches
C. Necessity for packing
D. Securing roof with I beam

IX. The gunnite method of cementing roof and its advantages

Method and Procedure.

1. The importance of timbering in mines should be stressed.
2. Proper methods of timbering to meet usual conditions should be studied.
3. Brief examination should be given on subjects covered.

References:

Coal Mine Timbering, Bulletin No. 40 by R. Z. Virgin—Federal Board for Vocational Education, Washington, D. C.

I. C. S. Mining Textbook—Timbering—International Text Book Co., Scranton, Pa.

Miners Circular No. 9, Accidents from Falls of Roof and Coal—Department of Interior, Bureau of Mines, Washington, D. C.

Unit	*Subject*	*Topics*
M. F. 8	*Mining Law* (1 hr.)	I. Laws relating to securing working places.

A. To be kept in safe condition
B. Examination by mine foreman or assistant
C. Examination by miner or workmen and report to mine foreman

Ref. B. M. L. of Pa.
Index p. 191

Method and Procedure:

1. Law should be studied at home and discussed in class.
2. Brief examination should be given. See State Mine Foreman's Examinations.

Unit	*Subject*	*Topics*
M. F. 9	*Drainage and pumps* (8 hours)	I. Source of water in mines A. Surface water B. Water-bearing strata II. Underground drainage A. Methods of carrying water 1. Ditches 2. Tunnels 3. Pipes B. Flat deposits 1. Adit drainage 2. Cross-entry drainage 3. Drainage of swamps 4. Drainage of abandoned and robbed workings C. Above water level D. Below water level 1. Sumps E. Inclined deposits 1. Above water level a. Adits for draining upper levels 2. Below water level F. Mine Dams 1. Location 2. Types 3. Water pressure and head G. Mine barriers III. Methods of raising water A. Bucket hoisting 1. Types 2. Capacity

B. Syphons
   1. Principle
   2. When used in the mines
   3. Flow of water
   4. Quantity of water delivered by syphon

C. Pumps
   1. Principle of
   2. Tubes of mine pumps
   3. Capacity
      a. Quantity of water delivered and sizes

D. Comparison of bucket hoisting and pumping

E. Pump houses

Method and Procedure:

1. The principles of drainage should be studied by the class from texts or other descriptive material available.
2. When studying drainage ditches, dams, barriers and methods of raising water, the class should solve problems involving fundamental calculations.
3. Brief examination should be given on this subject.

References:

I. C. S. Mining Text Books—International Text Book Company, Scranton, Pa.
Mine Drainage (1 part)
Mine Pumps (3 parts)

Unit	*Subject*	*Topics*
M. F. 10	*Mining Law* (1 hour)	I. Law relating to drainage A. Pump houses (Act of June 9, 1911) Ref. B. M. L. of Pa. Index p. 175 B. Drainage of water in abandoned portions, working places, etc. Ref. B. M. L. of Pa. Index p. 178 C. Drainage from buildings Ref. B. M. L. of Pa. Index p. 178

Unit	*Subject*	*Topics*
M. F. 11	*Explosives* (4 hours)	I. Permissible explosives A. Low explosives B. High explosives II. Requirements of mine explosives III. Means of firing A. Fuses and squibbs B. Detonators IV. Storage and handling of explosives V. Thawing dynamite VI. Transportation of explosives VII. Blasting and shot-firing A. Preparing and placing the charge B. Firing VIII. Principles of rock blasting

Method and Procedure:

1. Topics should be studied and discussed in accordance with methods used in local mines.
2. Brief examinations should be given in subject.

References:

I. C. S. Mining Text Books—Explosives and Blasting—International Text Book Co., Scranton, Pa.

Coal Miners' Pocketbook—Foster—McGraw

The following publications may be procured from the Department of Interior, Bureau of Mines, Washington, D. C.

Bulletin 10. The Use of Permissible Explosives.

Bulletin 15. Investigations of Explosives used in Coal Mines.

Bulletin 17. A Primer on Explosives for Coal Miners.

Bulletin 66. Tests of Permissible Explosives.

Bulletin 96. The Analysis of Permissible Explosives.

Technical Paper 108. Shot-firing in Coal Mines by Electricity Controlled from the outside.

Miners' Circular 7. Use and Misuse of Explosives in Coal Mining.

Blaster's Handbook—E. I. DuPont, DeNemous & Co., Wilmington, Del.

Unit	*Subject*	*Topics*
M. F. 12	*Mining Law* (1 hour)	I. Law in regard to explosives and their use in mines A. Explosives, Ref.—B. M. L. of Pa.—Index p. 179 B. Detonators, Ref.—B. M. L. of Pa.—Index p. 178 C. Blasting, Ref.—B. M. L. of Pa.—Index p. 176 D. Shot Firer E. Shot firing by electricity Ref.—B. M. L. of Pa.—Index p. 188

Method and Procedure:

1. After the work has been covered, a brief examination should be given.

Unit	*Subject*	*Topics*
M. F. 13	*Causes and prevention of accidents* (4 hours)	I. Causes of Mine Accidents A. Fall of roof and coal B. Mine cars and locomotives C. Explosive gas and coal dust D. Blasting E. Electricity and machinery F. Other Causes II. Prevention A. Systematic posting and spragging of coal respectively B. Rules and regulations controlling the handling of mine rolling stock C. Precautions to be taken to eliminate accumulations of gas and the treatment of coal dust. D. Education of shot-firers and miners in the handling and use of explosives.

E. Guarded equipment (mechanical and electrical) and instructions in connection with the hazard involved in the use of equipment.

F. Forethought in conjunction with past experience in actual accident occurrence.

G. Importance of discipline.

Method and Procedure:

1. Instructor should lecture to class on above topics and suggest sources of written material on the subject. Points of law should be covered thoroughly.
2. An examination should be given in the general principles outlined above.

References:

Bituminous Law of Pennsylvania—Rules as indicated on index p. 187.

The following Bulletins, etc., may be procured from Department of Interior, Bureau of Mines, Washington, D. C.

Bulletin 44. First National Mine-Safety Demonstration, Pittsburgh.

Bulletin 69. Coal Mine Accidents in the U. S. and Foreign Countries.

Bulletin 115. Coal Mine Fatalities in the U. S., 1870-1914, etc.

Bulletin 196. Coal Mine Fatalities in the U. S., 1919, etc.

Technical Paper 21. The prevention of mine explosions, etc.

Technical Paper 48. Coal Mine Accidents in the U. S. 1896-1912, etc.

Technical Paper 56. Notes on the prevention of gas and dust explosions in coal mines.

Technical Paper 138. Suggested Safety Rules for Installing and using Electrical Equipment in Bituminous Coal Mines.

Miners' Circular 5. Electrical Accidents in Mines, their causes and prevention.

Miners' Circular 9. Accidents from falls of roof and coal.

Miners' Circular 11. Accidents from Mine Cars and Locomotives.

Miners' Circular 13. Safety in Tunnelling.

Miners' Circular 20. How a Miner can avoid some dangerous diseases.

Miners' Circular 21. What a miner can do to prevent explosions of gas and coal dust.

Miners' Circular 22. Dangerous and safe practices in bituminous coal mines.

Unit	*Subject*	*Topics*
M. F. 14	*Review* (6 hours)	I. A general review of the first year course for mine foremen.

Final Examination

The examination should cover all of the work given throughout the course. It should be given under the direction of the examining board described previously.

PART VI

EVENING COURSE FOR MINE FOREMEN IN BITUMINOUS COAL MINES

Part II—Second Year

11 Units—60 Hours

Prerequisites for entrance:

1. Completion of Evening Course for Mine Foremen and assistant Mine Foremen—Part I or equivalent preparation.

Course Outline

Unit	*Subject*	*Topics*
M. F. 15	*Review* (14 hours)	I. Ventilation and mining law (6 hours)
		II. Methods of work and mining law (2 hours)
		III. Securing underground workings and mining laws (2 hours)
		IV. Drainage and pumps and mining law (2 hours)
		V. Explosives and mining law (1 hour)
		VI. Causes and prevention of accidents (1 hour)

Method and Procedure:

1. A complete review should be conducted on the topics indicated. The men at this time will benefit much by going over the work in an intensive manner.
2. The teacher should draw largely from the experiences and future requirements of the men in determining the points to be stressed in the review.
3. For the purposes of review the instructor may use the outline of courses given in Part I of this course.

Unit	*Subject*	*Topics*
M. F. 16	*Hoisting* (8 hours)	I. Hoisting methods A. The hand windlass B. The horse-power windlass C. The steam power hoists D. The compressed air E. The gasoline hoists F. The electrical hoists II. Hoisting appliances A. Ropes B. Fittings C. Indicators D. Clutches E. The Cage III. Drums, pulleys and gears A. Speed ratios B. Power ratios C. Calculations IV. Safety precautions V. Signal apparatus A. Installation B. Use

Method and Procedure:

1. Material should be available to permit home study on part of members of class.
2. Hoisting methods and appliances should be studied from the standpoint of use only. No attempt should be made to study in detail all of the machines. The application of machines, etc. to mining practice should be discussed in class

3. The study of drums, pulleys, etc. is for the purpose of giving the student an understanding of the parts of machines and their action. Problems should constitute a large part of the work of this topic.
4. Brief examination should be given on this subject.

References:

I. C. S. Mining Textbooks—Hoisting (4 parts)—International Text Book Company, Scranton, Pa.

Coal Miner's Pocketbook—Foster—McGraw.

Unit	*Subject*	*Topics*
M. F. 17	*Mining Law* (1 hour)	I. Law relating to hoisting coal A. Hoisting in shafts B. Hoisting in slopes Ref.—B. M. L. of Pa.—Index p. 188 C. Cages D. Hoisting Cars Ref.—B. M. L. of Pa.—Index p. 176 E. Signalling Ref.—B. M. L. of Pa.—Index p. 188

Method and Procedure:

1. Study, recitation and discussion should be conducted in same manner as previously indicated.
2. Examination should be given on law relating to hoisting.

Unit	*Subject*	*Topics*
M. F. 18	*Haulage and Trackwork* (10 hours)	I. Methods of haulage A. Haulage by animals B. Haulage by inclines C. Haulage by rope D. Haulage by main and tail rope E. Haulage by endless rope F. Haulage by electric locomotives G. Haulage by gasoline locomotives

II. Adaptability to various methods; to mine conditions
III. Quantity of coal hauled using various methods
  A. Comparison of effectiveness and efficiency of various methods
    1. Definitions
    2. Rule to find best gradient for roadway (Mule haulage or inclined plane)
  B. Gradient
IV. Locomotives
  A. Types of locomotives
  B. Size of locomotives for a given out-put
V. Mine cars
  A. Types of cars
  B. Construction
  C. To find the frictional resistance of mine cars, experimentally
VI. Track work
  A. Types of track
  B. Gradient
  C. Materials
    1. Kinds
    2. Curves
    3. Switches and frogs
    4. Calculations

Method and procedure:

1. In addition to study of means and methods of haulage, problems involving capacity, gradient and comparison of various types should be solved.
2. Brief examinations should be given in this subject.

References:

I. C. S. Textbooks—Haulage—Trackwork—International Text Book Company, Scranton, Pa.

Coal Miners' Pocketbook—Foster—McGraw.

Coal Miners' Handbook—International Text Book Co., Scranton, Pa.

Unit	*Subject*	*Topics*
M. F. 19	*Mining Law* (1 hour)	I. Laws relating to haulage and and haulage roads A. Duties of driver and trip rider Ref.—B. M. L. of Pa.—Index pp. 178-190 B. Duties of motorman and locomotive engineer. Ref.—B. M. L. of Pa.—Index pp. 181-185 C. Duties of hooker-on Ref.—B. M. L. of Pa.—Index p. 181 D. Rule 15 of General Rules Ref.—B. M. L. of Pa.—Index p. 187 E. Haulage roads 1. Shelter holes and clearance 2. Steam Pipes 3. Not to obstruct by refuse, etc. 4. In unsafe condition 5. Cables Ref.—B. M. L. of Pa.—Index p. 181

Unit	*Subject*	*Topics*
M. F 20	*Shaft Sinking and Tunnels* (4 hours)	I. Methods of shaft sinking A. Through ordinary strata B. Through soft strata C. Special methods II. Types of shafts A. The square or rectangular shaft B. The circular shaft C. Comparison between circular and rectangular shafts

III. Tunnelling
  A. Types of tunnels
IV. Excavation
  A. Quantity of earth and rock
  B. Cost of excavation
V. Ventilation of shafts during excavation

Method and Procedure:

1. Topics should be studied at home by students. Recitation and discussions on methods of sinking, types, etc. should take a considerable part of the class period.
2. Problems on excavation should be solved by each member of class.
3. A brief examination should be given.

References:

I. C. S. Mining Text Book—Drifts, Slopes and Shafts (1 part)—International Text Book Co., Scranton, Pa.

Unit	*Subject*	*Topics*
M. F. 21	*Mining Law* (1 hour)	I. Law relating to shaft sinking A. Excavations Ref.—B. M. L. of Pa.—Index p. 179 B. Definition of shafts and Slopes Ref.—B. M. L. of Pa.—Index p. 188 C. Sinking of shafts Ref.—B. M. L. of Pa.—Index p. 188

Unit	*Subject*	*Topics*
M. F. 22	*Electricity in the Mines* (10 hours)	I. Electric circuits A. Series and parallel II. Ohm's law A. Voltage, current, resistance B. Calculations

III. Magnetism and generation of electricity

IV. Wiring methods

A. Light
B. Power

V. Heating effect of electric current

A. Electric lamps
B. Power consumption

VI. Signal apparatus

VII. Electric locomotives

A. Types used in mines
B. Power consumption

VIII. Types of electric coal cutting machinery

A. Power consumption

Method and Procedure:

1. The amount of time available for this work is so small that the instruction must be very intensive and practical. Explanations should supplement the recitation work of the class. An effort should be made to encourage additional study after completion of course.
2. Problems should be solved involving calculations with Ohm's law.
3. A brief examination in the subject should be given.

References:

I. C. S. Mining Text Books. International Text Book Co., Scranton, Pa.

Elements of Electricity and Magnetism (1 part)
Direct Current Dynamos and Motors (1 part)
Alternating Current Machinery (1 part)
Operation of Dynamo Electric Machinery (2 parts)
Transmission Lighting and signalling (1 part)

Coal Miners' Pocketbook—Foster—McGraw.

Electricity in Coal Mining—Shearer—McGraw.

The following bulletins and circulars may be procured from the Department of Interior, Bureau of Mines, Washington, D. C.

Bulletin 68. Electric switches for use in gaseous mines.
Technical Paper 23. Ignition of Mine Gas by Miniature Electric Lamps with Tungsten Filaments.

Technical Paper 28. Ignition of Mine Gases by Standard Incandescent Lamps.

Technical Paper 128. Shot-Firing in Coal Mines by Electricity Controlled from the Outside.

Technical Paper 138. Suggested Safety Rules for Installing and using Electrical Equipment in Bituminous Mines.

Miners' Circular 5. Electrical Accidents in Mines, Their Causes and Prevention.

Unit	*Subject*	*Topics*
M. F. 23	*Mining Law* (1 hour)	I. Law relating to electricity in mines A. Electricity; Rules for installation and use. B. Electrician C. Electric lamp D. Electric Locomotives E. Electric coal cutting machines

Unit	*Subject*	*Topics*
M. F. 24	*Standards of Safety* (4 hours)	I. Standards of safety as laid down in the *Coal Mine Section, Pennsylvania Compensation and Inspection Bureau* A. General safety standards B. Surface hazards C. Shaft and slope hazards D. Haulage underground E. Electricity underground F. Height of coal and falls G. Explosives H. Gas, dust and fires I. Miscellaneous underground hazards Ref.—Pa. Bituminous Coal Mine Compensation Rating Schedule 1921 (Pamphlets containing these standards, may be obtained free from Coal Mine Section, Penna. Compensation Rating and Inspection Bureau, Harrisburg, Pa.)

Method and Procedure:

1. Each student should own a copy of the rating schedule mentioned above.
2. Students should study the items which give the safety requirements under each heading.
3. Considerable home study should be required for this subject. Class work should be mostly discussion.

Unit	*Subject*	*Topics*
M. F. 25	*Review* (6 hours)	1. The final review should take in all of the subjects studied in Part I and Part II of the "Mine Foremen's Course."

Final Examination

The final examination should cover the work given throughout both parts of the Mine Foremen's Course. It should be conducted by the examining board previously described.